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The Awful Eight Lesson Plan

Purpose

To become aware of different air pollutants and their causes and effects.

Grade Level

Sixth to eighth grade

Essential Elements

Sixth grade science 3B, 4B; seventh grade science 3B, 9C, 1.3, 1.6; social studies 5D, 7C; eighth grade science 3B, 9C, 9F, 1.3.

Objective

The students will be able to list major air pollutants, what causes them, and their effects on people and the environment.

Focus

After studying air pollution, students will present a play about the different pollutants.

Materials

Markers, yardsticks, large pieces of poster board, background information on air pollution, library books that cover air pollutants, materials for "costumes" copies of play for each student, video camera.

Background

The U.S. Environmental Protection Agency (EPA) has established national ambient air quality standards for six air pollutants - ozone, carbon monoxide,

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sulphur dioxide, nitrogen dioxide, respirable particulate matter, and lead.

Volatile organic compounds (VOCs) are emitted from sources as diverse as automobiles, refineries, chemical manufacturing, dry cleaners, paint shops, and other sources using solvents. VOCs are precursors to ground-level ozone, and some of the VOCs are toxic.

Chlorofluorocarbons (CFCs) are a family of chemicals commonly used in air conditioners and refrigerators as coolants and also as solvents and aerosol propellants. CFCs drift into the upper atmosphere where their chlorine components destroy upper-level ozone. CFCs are thought to be a major cause of the ozone hole over Antarctica.

The main man-made source of carbon dioxide emissions is fossil fuel combustion for energy-use and transportation. Methane comes from landfills, cud-chewing livestock, coal mines, and rice paddies. The extent of the effects of climate change - or the "greenhouse effect" on human health and the environment is still uncertain, but could include increased global temperature, increased severity and frequency of storms and other "weather extremes," melting of the polar ice cap, and sea-level rise.

Ground-level ozone is a photochemical oxidant and the major component of smog. Ground-level ozone is not emitted directly into the air but is formed through chemical reactions between natural and man-made emissions of VOCs and oxides of nitrogen in the presence of sunlight. Since the reactions are stimulated by temperature, peak ground-level ozone concentrations occur in the summer months. Elevated levels above the national standard may cause lung and respiratory disorders. Short-term exposure can result in shortness of breath, coughing, chest tightness, or irritation of nose and throat. Individuals exercising outdoors, children, the elderly, and people with pre-existing respiratory illnesses are particularly susceptible.

Nitrogen dioxide is formed both by the combustion of nitrogen and the reaction of nitric oxide with oxygen in the atmosphere. Nitrogen dioxide emissions result almost entirely from fuel combustion by industry, energy producers, and motor vehicles. In addition to being a precursor to ground-level ozone, oxides of nitrogen react chemically in the atmosphere to form nitrates. These pollutants can be transported long distances from the source and can contribute to acid rain and impair visibility. Nitrogen dioxide can harm humans at elevated levels above the national standard. In particular, may cause increased respiratory illness such as chest colds and coughing with phlegm in children. For asthmatics, can cause increased breathing difficulty.

Carbon monoxide is produced by incomplete combustion of carbon in fuels. The majority of carbon monoxide emissions come from transportation sources, principally from highway motor vehicles. Carbon monoxide reduces blood's

ability to deliver oxygen to vital tissues, affecting primarily the cardiovascular and nervous systems. Lower concentrations have been shown to adversely affect individuals with heart disease and to decrease maximal exercise performance in young. Higher concentrations above the national standard can cause symptoms such as dizziness, headaches, and fatigue.

Sulphur dioxide results primarily from combustion of sulphur-bearing fuels, smelting of sulphur-bearing metal ores, and industrial processes. Major sulphur dioxide emission sources are power plants, refineries, some types of chemical plants, primary metal smelters, and cement plants. These pollutants can be transported long distances from the source and can contribute to acid rain and visibility impairment. Sulphur dioxide becomes sulfuric acid once it comes in contact with moist mucous membranes. At elevated levels above the national standard, it irritates the respiratory tract, causing restricted air flow and breathing difficulty. Individuals with pre-existing pulmonary disease are particularly susceptible to these effects.

Respirable particulate matter includes dust, dirt, soot, smoke, and aerosols emitted into the air by various sources. Major sources of particulate pollution are factories, power plants, refuse incinerators, motor vehicles, construction activity, fires, and natural windblown dust. These microscopic particles can be inhaled and deposited deep in the lungs where they can be trapped on membranes. If trapped, they can cause excessive growth of fibrous lung tissue, which leads to permanent injury. Children, the elderly, and people suffering from heart or lung disease are especially at risk.

The primary sources of lead in the atmosphere are lead-containing gasoline additives, nonferrous smelters, and battery plants. There has been a steady decline in lead levels in the air as a result of the phase out of leaded gasoline and pollution control programs. Elevated levels above the national standard can adversely affect mental development and performance, kidney function, and blood chemistry. Young children are particularly at risk due to their increased sensitivity of young tissues and organs.

Your group can learn about some of the major air pollutants by putting on a play called *The Awful 8*. By performing the play, they can teach other people about the pollution problems in our atmosphere.

Assign each part under the "Cast of Characters" and pass out copies of the play. Give the kids time to learn their lines, design costumes, and plan any special effects they might want to add.

After the group performs the play, review the eight major air pollutants by having each "pollutant" come out and take a bow. The Pollutants should state their name; what causes them; how they affect people, wildlife and the environment; and what people can do to help reduce this type of pollution. Or you can have the audience

supply this information to see how much they learned from watching The Awful 8.

Procedure

1. Distribute copies of the play to each student.
2. Have class read play aloud, following seating arrangement for each part.
3. Assign students to different roles; for homework practice lines and bring own props.
4. Next 3 days - practice play.
5. Present and/or video record play when students are ready.

Closure

List ways we can prevent or reduce the types of air pollution mentioned in the play.

Enrichment

1. Put a Sock On It Activity - place a white sock over a car's tailpipe; have adult start engine and let run for a few minutes; inspect sock and compare with a clean sock.
2. Brainstorm solutions to air pollution problems - be creative.

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The Awful 8: The Play

A play about eight major air pollutants

CAST OF CHARACTERS

The number of characters and some suggestions for props and costumes are in parentheses.

Connie Lung, reporter (1; props: microphone, notebook)

Harry Wheezer, reporter (1; props: microphone, notebook)

The Particulates (3; prop: dirt; costume: dirty jeans and brown t-shirts, smear dirt on face)

Carbon Monoxide (1; costume: sneakers, hat, trench coat, and sunglasses)

The Toxins (5; props: gasoline cans made from cardboard; costume: black clothing)

Sulfur Dioxide (1; prop: water gun or spray bottle filled with water; costume: torn t-shirt, yellow and white streamers attached to clothing)

Nitrogen Oxides (Nitros) (5; props: dead branches; costume: each Nitro can wear one of the letters in "nitro")

Bad Ozone (1; costume: sunglasses, sophisticated clothing for a "big city look")

Good Ozone (1; costume: sunglasses and light-colored clothing with bits of cotton attached to represent clouds)

Chlorofluorocarbons (CFCs) (4; costume: heavy coats and jackets with the initials "CFC" stapled to the lapel and on the back, gloves and scarves)

EPA Scientists (2; prop: notebooks)

Carbon Dioxide (2; costume: t-shirts and shorts, black costume makeup wiped on

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clothing, legs and faces)

Tips For Putting On The Play

* Have the Pollutants make picket signs by taping large pieces of poster board to yardsticks and writing slogans on the poster board. (See slogan suggestions in description of the play's setting.)

* If some kids prefer non-speaking roles, you can let them carry picket signs or be camera people filming the report. They could also take on the responsibilities of stage manager, costume designer or set designer.

* Go over these pronunciations with the kids playing the Toxins; benzene (BEN-zeen), xylene (ZI-leen), toluene (TOL-you-eeen).

* If your audience is small, have Harry and Connie come up with some ways that people can help reduce air pollution at the end of the play.

Setting: In front of the Environmental Protection Agency (EPA) building. The air pollutants are picketing the EPA. Some carry picket signs with phrases such as "Dirty Air! Let's Keep It That Way," "Down with the Clean Air Act" and so on. TV reporters Connie Lung and Harry Wheezer are at center stage. In turn, each pollutant comes over to be interviewed, while the other pollutants continue to picket in the background.

Connie: Hi! I'm Connie Lung.

Harry: And I'm Harry Wheezer. We're here at the Environmental Protection Agency to cover a late-breaking story. Eight of the world's worst air pollutants are picketing the EPA to protest clean-air legislation.

Connie: In tonight's special report, we'll give you the scoop on where these pollutants come from and the ways they can hurt people and other living things.

Harry: Our first interview is with the Particulates. (Particulates walk over, carrying signs and chanting.)

Particulates: Dust, soot and grime.

Pollution's not a crime

Soot, grime and dust,

The EPA's unjust!

Connie: (coughs) So-- you're the Particulates.

Particulates 1(Soot): Yeah- I'm Soot, this is Grime and this is Dust.

Harry: You guys are those tiny bits of pollution that make the air look really dirty?

Grime: Yeah! Some of us are stirred up during construction, mining and farming. (throws some dirt in air)

Soot: But most of us get into the air when stuff is burned-- like gasoline in cars and trucks or coal in a power plant and even wood in a wood-burning stove!

Dust: And we just love to get into your eyes and make them itch and make your throat hurt and...

Grime: (interrupts) Come on, Dust, quit bragging! We gotta get back to the picket line. (Particulates return to picket line. Carbon Monoxide sneaks up behind Harry.)

Harry: Let's introduce the folks at home to our next pollutant, Carbon Monoxide. Hey, where did he go? Oh, there you are! Pretty sneaky, Carbon Monoxide!

Carbon Monoxide: Yeah, sneaking up on people is what I do best. I get into the air when cars and trucks burn fuel inefficiently -- but you can't see or smell me.

Connie: Then how can we tell when you're around?

Carbon Monoxide: You'll find out when you breathe me in! I can give you a bad headache and make you really tired. (gives an evil laugh)

Harry: (yawns) Oh-- I see what you mean. Thanks for talking with us Monoxide. (yawns again) (Carbon Monoxide returns to picket line.) **Connie:** (checking notes) Next we'd like you to meet some of the most dangerous air pollutants-- The Toxins. (Toxins walk over, carrying signs and chanting.)

Harry: You Toxins are made up of all kinds of poisons. How do you get into the air?

Toxins 1: Hey, man, we come from just about everywhere. Chemical plants, dry cleaners, oil refineries, hazardous-waste sites, paint factories...

Toxins 2: Yeah, and cars and trucks dump a lot of us into the air too. You probably don't know it, but gasoline is loaded with us toxins.

Toxins 3: Wow, that's for sure. There's benzene, toluene- all kinds of great stuff in gas.

Connie: Scientists say you cause cancer and other kinds of diseases. What do you

think of that?

Toxins 4: They can't prove a thing!

Toxins 5: That's why we're here-- to make sure you people don't pass any more laws that might keep us out of the air. C'mon, Toxins- we're outta here! (Toxins return to picket line. Sulphur Dioxide walks over.)

Connie: Next we'd like you to meet Sulphur Dioxide. (Turns to face Sulphur Dioxide) I understand you just blew in from the Midwest.

Sulphur: Hey, I wouldn't miss this for all the pollution in New York City!

Harry: I'm sure the folks at home would like to know how you get into our air.

Sulphur: Well, heck, don't they read the newspapers? I've been making the front page at least once a week! Most of the time, I shoot out of smokestacks when power plants burn coal to make electricity.

Connie: And what kinds of nasty things do you do?

Sulphur: Nasty-- that's me! (snickers) I think it's cool to make it hard for some people to breathe. And I can make trees and other plants grow more slowly. But here's the most rotten thing I do: When I get way up into the air, I react with oxygen in water in the sky, and presto! You get acid rain! (sprays water at audience)

Harry: Acid rain is a big problem. It can hurt or kill fish and other animals that live in lakes and rivers and some scientists think it makes trees sick. Acid rain can even eat away at statues and buildings.

Sulphur: (proudly) That's right. Hey, I can even travel a long way to do my dirty work. If I get pumped out of a smokestack in Ohio, I can ride the wind for hundreds of miles and turn up as acid rain in Vermont!

Connie: I sure hope we can get rid of you soon, Sulphur Dioxide!

Sulphur: Good luck, guys! I gotta do some more picketing before I catch the next east wind! (Sulphur Dioxide returns to picket line. Nitros walk over.)

Harry: (to the audience) He's really rotten!

Nitros: (all together) You think Sulphur Dioxide is rotten? You haven't met us!

Connie: You must be the Nitrogen Oxides.

Nitro 1: Just call us the Nitros for short. (turns to audience) Give me an "N"!

Audience and other Nitros respond: "N"!

Nitro 2: Give me an "I"!

Audience and other Nitros respond: "I"!

Nitro 3: Give me an "T"!

Audience and other Nitros respond: "T"!

Nitro 4: Give me a "R"!

Audience and other Nitros respond: "R"!

Nitro 5: Give me an "O"!

Audience and other Nitros respond: "O"!

Nitro 1: What's that spell?

Audience and other Nitros: NITRO!

Nitro 2: What's that mean?

Other Nitros: DIRTY AIR!

Harry: Hey, I didn't know pollutants could spell.

Nitro 4: Very funny, Harry.

Connie: So, how do you Nitros get into the air?

Nitro 5: We get airborne when cars, planes, trucks and power plants burn fuel.

Harry: And what happens once you're in the air?

Nitro 1: We can make people's lungs hurt when they breathe-- especially people who already have asthma.

Nitro 2: And, like Sulphur Dioxide, we react with water in the air and form acid rain.

Nitro 3: But we also make another form of pollution. And here she is-- BAD OZONE! (Bad Ozone waves and walks over. Nitros return to picket line.)

Bad Ozone: Well, my friends, the Nitros, pour into the air, they get together with some other pollutants. As the sun shines on all these lovely pollutants, it heats them up-- and creates me, Bad Ozone. And where there's ozone, there's smog.

Harry: (to audience) Smog contains a lot of ozone.

Connie: That's right, Harry. And smog can really make city life miserable. It can make your eyes burn, your head ache and it can damage your lungs.

Harry: But what I want to know is, if ozone is so bad, why are people worried about holes in the ozone layer? (Good Ozone walks in from offstage.)

Good Ozone: That low-level ozone is my rotten twin sister-- she's just a good gas turned bad! I'm the good ozone that forms a layer high above the Earth. I help absorb the harmful rays of the sun.

Bad Ozone: (nastily to Good Ozone) So what are you doing here, sis?

Good Ozone: I'm here to support the clean air laws. If certain chemicals keep getting pumped into the atmosphere, I'll disappear. And without me, the harmful rays of the sun will kill some kinds of plants and give many more people skin cancer and eye disease!

Harry: But what kinds of chemicals are making you disappear?

Good Ozone: It's those terrible CFCs! (CFCs walk over from picket line.)

CFC 1: Hey, we're not so bad! People have used us CFCs in coolants for refrigerators and air conditioners for your home and car.

CFC 2: So what if we destroy a little bit of ozone? There's enough to last for years!

CFC 3: Yeah- who needs ozone anyway?

Good Ozone: People do! Tell them what else you CFCs are doing!

CFC 4: What's Ozone complaining about now- global warming? (EPA scientists walk in from offstage. Good and Bad Ozone walk offstage.)

Scientist 1: Excuse me, but did I just hear someone mention global warming?

CFC 2: Yeah. What do you want?

Scientist 2: We just happen to be experts on global climate change.

Connie: Are CFCs really changing the world's climate?

Scientist 1: Well, we're not positive. But over the past 100 years or so, people have been pouring gases, such as CFCs and carbon dioxide, into the air.

Scientist 2: And as they build up in the atmosphere, these gases may be acting like the glass in a greenhouse.

Scientist 1: That's right. They let the radiation from the sun in -- but they keep the heat from getting out. And this may be causing the Earth's climate to become warmer.

Harry: I've read that if the temperature goes up, sea levels may rise. Wow, some cities on the coast might be flooded some day!

Scientist 1: Well, nice talking with you all, but we've got to do some more research so that we can really nail these pollutants. (Points to CFCs. CFCs give scientists a dirty look, stick out tongues. Scientists walk offstage.)

CFC 1: Hey, we're not even the biggest cause of global climate change. You gotta talk to another of the big pollutants about that.

Harry: (checks notes) There's only one other pollutant on the list: Carbon Dioxide. (CFCs return to picket line. Carbon Dioxide 1 and 2 walk over.)

Dioxide 1: Did we hear you mention our name? We aren't really a bad gas, in the right amount. About a hundred years ago, there was just the right amount of us in the air.

Dioxide 2: But then people started burning more and more things -- they built power plants that burn coal, and cars and trucks that burn gasoline. And they started cutting down and burning forests! Every bit of that burning releases extra amounts of us into the air.

Dioxide 1: As more and more of us got into the air, people started saying that the Earth was warming up-- because of us!

Dioxide 2: Yeah-- like it's our fault! (to audience) The reason you're in such a mess is because you use so much fuel and cut down so many trees!

Connie: You're right, Carbon Dioxide. Maybe we should be doing a special report on people-- we're the ones who are really causing most air pollution.


Harry: But people can change! (turns to audience) How about you? Can you think of some ways that people can help fight air pollution? (Audience responds with ideas, such as driving cars less, using less electricity, conserving forests, planting trees and so on.)

Connie: And that's the end of our special report. The bottom line? These air pollutants are a pretty tough bunch-- but people help create much of them, and people can reduce the amounts that are in our atmosphere. Thank you and good night.

Pollutant curtain call.

The End.

Acknowledgments

Lois Myers, Stephen F. Austin University Nacogdoches TES Course, 1994;
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